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CONTAINMENT LEAK SEARCH DURING BRUCE NGS 'A' 1989 STATION OUTAGE

Report No. 91-117-K

T. Jarv
Scientist
Environmental Science Section
Chemical Research Department

ABSTRACT

The containment volume at the newer CANDU nuclear generating stations is maintained at negative pressure to minimize radionuclide dispersion. The containment volume is periodically pressurized to evaluate the integrity of containment and to test for leakage. A tracer gas technique was used during the May 1989 four-unit outage at Bruce NGS 'A' to identify containment areas experiencing leakage. A 2.6% ethylene in nitrogen mixture was injected into containment during pressurization. Over 500 samples of station air were collected and analyzed for evidence of tracer gas. Tracer gas measurements indicated that the largest source of leakage arose from the lower levels of Unit 0 (579', 591' and 615' elevations) and not from the boiler rooms as was indicated in the May 1987 outage. The application of soap spray around known penetrations into containment is efficient at locating Type 1,2 and smaller Type 3 leaks, but these leaks represented <10% of the total measured leakage. Over 30 areas of high tracer gas were identified and investigated in detail by the crews using soap spray. The worst areas of leakage were construction joints and expansion joints and the PRV EP's. No large turbulent leakpath was found, but rather many small ones were located. The ultrasonic technique was successfully used to search out instrument air leaks in Unit 1 containment.

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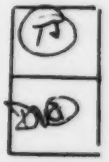
EXECUTIVE SUMMARY

CONTAINMENT LEAK SEARCH DURING BRUCE NGS 'A' 1989 STATION OUTAGE

T. Jarv
Environmental Science Section
Chemical Research Department

Ontario Hydro's newer CANDU type nuclear plants, have a physical containment barrier to minimize the potential release of radionuclides. Periodic tests are required by the AECB to demonstrate both the integrity of the containment boundary and that the air leakage rate is less than 2% per hour at design pressure. As part of the May 1989 BNGS 'A' station outage, a positive pressure test was conducted during which the entire containment volume (reactor vaults, fuelling machine ducts and service areas) was pressurized and the leak rate measured at containment pressures of 15 kPag and 82 kPag. A search for leakage sites was conducted in parallel.

Spraying soap solution at suspected leak sites is the conventional technique for leak detection. It is however limited in application and is both labour- and time-intensive. For the study described in this report, ethylene tracer gas was injected into containment to achieve an internal concentration of approximately 52 ppm. Subsequent analysis of station air around containment with two comprehensive air sampling sweeps revealed over 30 areas having elevated tracer gas levels including the fuelling machine maintenance area in Unit 0, the vacuum building basement, the moderator rooms (R105 and R106), the construction joints in the central service area on elevation 579' and Room 025 by Unit 4. The only Unit boiler rooms with any detectable inleakage were those of Unit 2. This was a significant improvement in boiler room leakage from the results obtained during the May 1987 outage.



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To: Mr. A.G. Holt
Station Manager
Bruce NGS 'A' - Operations

CONTAINMENT LEAK SEARCH DURING BRUCE NGS 'A' 1989 STATION OUTAGE

1.0 INTRODUCTION

At Ontario Hydro's newer nuclear generating stations, a physical containment barrier which encompasses the four reactors, the fuelling machine duct, the pressure relief manifold and the services areas, minimizes the potential release of radionuclides. Periodic tests are required by the AECB to demonstrate both the integrity of the containment boundary and that the air leakage rate is less than 2% per hour of the contained volume at design pressure of 69 kPag. During operation the reactor vault system at Ontario Hydro's nuclear stations is maintained at approximately 3 kPag below atmospheric pressure in order to reduce dispersion of radioactive contamination. The operating inleakage specification for Bruce NGS 'A' is 1% of total contained volume per hour (2680 kg/h) at 69 kPag.

During the May 1989 Bruce NGS 'A' station outage, a positive pressure test was conducted to assess the leak tightness of containment at peak LOCA pressure (82 kPag) and also to test the newly installed button-up dampers on all vapour recovery (VRS) inlet and outlet ducts. The entire containment volume (reactor vaults, fuelling machine ducts and service areas) was pressurized and the leak rate measured at various pressures. Concurrently two tracer gas leak searches for leakage sites were conducted at two different containment positive pressures (15 kPag and about 75 kPag).

The conventional method used to locate leaks has been the application of soap spray to suspected areas (penetrations into containment) and subsequent observation of the rate of bubble formation resulting from escaping air. However, this method is limited to known or suspected leak sites such as accessible penetrations or cracks in concrete, is labour- and time-intensive,

is incapable of detecting leaks in inaccessible areas of the station and provides approximate flow rates and then only for relatively small leaks.

The 1987 four unit Bruce NGS 'A' pressure test was the first full-scale opportunity to apply new techniques such as tracer gas, ultrasonic detection and direct leakage rate measurement under field conditions/1/. The 1987 test results clearly showed the advantages of tracer gas leak detection as used in a large operating nuclear station to complement the traditional soap spray technique. The tracer gas technique was useful in detecting unsuspected leaks, required less exposure time when leak searching in radiation fields and could be used easily in relatively inaccessible areas. During the May 1987 outage, the leak catcher and ultrasonic detection techniques were demonstrated as operational tools to determine the significance of identified leaks and locate leaks in underground areas of containment and inside containment, respectively. For the May 1989 outage described in this report, the tracer gas leak search, ultrasonic detection and leak catcher were again called upon to locate suspected leak sites (eg. cracks and penetrations). The soap spray technique was used to supplement the tracer gas results by pinpointing the actual leakage locations.

1.1 Strategy

To ensure thorough sampling of the air in the entire station, 250 sample sites were identified from an examination of station floor plans and consultation with station personnel. These samples sites were located close to known containment penetrations, near auxiliary systems and in areas which might indicate leakage due to poor isolation. The sampling sites used for the tracer gas leak survey of the station are listed in Table A1 in the Appendix.

Tracer gas injection into containment occurred during the pressurization period to 15 kPag. After stabilizing at 15 kPag for about an hour, air samples were collected throughout the station using Tedlar plastic bags. Once these area air samples were analyzed by sensitive gas chromatography and evaluated, soap crews were dispatched to areas in the vicinity of the more serious leaks identified from the bagged samples to attempt to locate specific leak locations.

In order to determine if a particular leak site is a significant contributor to the total station leakage, reliable quantitative estimates of the leakage rate could be obtained using the leak catcher developed previously. This device and its calibration are more completely explained elsewhere /2/.

Some locations in the stations are not amenable to the application of soap solution or measurement of tracer gas since the exterior of the containment boundary is underground (eg. the north side of the

fuelling machine duct on elevation 579') or the leaks are in containment (eg. from instrument air systems). In these situations, the ultrasonic noise created by escaping turbulent airflow can be detected and a parabolic ultrasonic detector was available for leak searching.

2.0 EXPERIMENTAL

2.1 Tracer Gas Injection

Ethylene, which can be detected relatively easily, was used as the tracer gas. A 2.6% mixture of ethylene (lower explosive limit (LEL) of 3.1% in air) in nitrogen was injected from 36 cylinders via manifold into the air lines used for containment pressurization immediately upstream of the system outlet (EP 1057) on vaults 1, 3 and 4 and directly into vault 2 via EP 1057. Custom manifolds and high flow Victor Equipment Company Model VTS 452E gas regulators each with a CGA-350 gas bottle fitting were used to inject about 220,000 litres of the ethylene mixture into containment during the initial 2 hour pressurization period to 15 kPag. Injection of the tracer gas mixture into the pressurization air facilitated mixing in containment. The containment pressurization and tracer gas injection was begun at approximately 06:45 on May 19, 1989. The tracer gas concentration was projected to be about 52 ppm at a containment pressure of 15 kPag.

2.2 Details of Tracer Gas Sample Collection

Tedlar (Dupont) polyvinyl fluoride bags, each connected to a small battery-powered (3.0 V) variable resistor throttled and switch-operated pump, were used for air sampling. Over 500 air samples were collected during the two tracer gas leak searches. For the first leak search, about 250 samplers were placed at predetermined locations throughout the station by 18 Bruce NPD Central Maintenance Facility (CMF) personnel, each of whom performed up to three trips with 2 to 9 samples each. Each motor was activated manually and left to run for approximately 2-10 minutes. Each bag was sealed mechanically with a Dura-clamp and returned for analysis to the Mobile Research Laboratory (MRL) situated between Units 3 and 4 on elevation 615'.

The first complete sampling sweep of the exterior of Bruce NGS 'A' containment began at about 13:00 EDT on May 19 at a containment pressure of 15 kPag and ended about 15:00 EDT of the same day and at the same pressure. A further 13 samples were obtained to confirm high leakage areas. Sample bags equipped with battery operated timers were also placed inside containment to confirm the vault ethylene concentration.

During the pressurization to 82 kPag, the pressure test had to be terminated when a transfer chamber (24122-TC3) service side door seal failed to seal at a pressure of about 43 kPag. Containment

was returned to atmospheric pressure and the test boundary was changed to the containment side doors of 24122-TC1 to TC4. The pressure test was restarted from the beginning on May 20, 1989.

Two containment air samples were obtained prior to repressurization and analyzed to confirm containment ethylene concentration (Table A2 in the Appendix, Trip 43). The venting of containment back to atmospheric pressure after the failure of the transfer door seal reduced the tracer gas concentration from 52 ppm to about 34 ppm. The tracer gas concentration in containment after repressurization to the peak pressure of 82 kPag was estimated to be about 19 ppm.

The second tracer gas leak search of the outside of containment at a much higher containment pressure offered the opportunity to evaluate the effect of pressure on the tracer gas leak search and to determine whether the number of leak locations increases with increased containment pressure. The second round of sampling was begun at about 09:00 EDT on May 21 at a containment pressure of about 70 kPag and was completed by approximately 11:00 EDT on the same day at a containment pressure of about 82 kPag.

2.3 Tracer Gas Sample Analysis

Two Photovac gas chromatographs (Models 10S50 and 10S30), equipped with photoionization detectors (PID), were used to analyze the air samples. The Photovac Model 10S50 had a built-in integrator whereas the Model 10S30 required an external integrator. The signal from the Model 10S30 detector was recorded on a Varian Model 4290 signal integrator.

The carrier gas was ultrapure air (Matheson) and was passed through a hydrocarbon scrubber prior to entering each gas chromatograph. The carrier gas flowrate for both gas chromatographs was about 10 mL/min. The ethylene detection limit was about 5 ppb for both instruments. The column used in each gas chromatograph was a 2.4 m x 0.318 cm OD Teflon tubing packed with 1.5% XE-60/1% H_3PO_4 on Carbopack B, 60/80 mesh. The injection volume was 1 mL.

2.4 Gas Chromatograph Calibration

Two primary standard calibration gases of ethylene in ultra pure air (1.0 ppm and 99.5 ppm) were purchased from Matheson with each having a quoted concentration tolerance of ±1%. Additional concentrations were generated using a dynamic dilution system described in an earlier report /3/. The calibration gas samples were blown into Tedlar bags and the concentrations determined in the same manner as for the field samples. The accuracy of the generated calibration concentrations was about ±2%.

2.5 Ultrasonic Detection

Some locations in the station are not amenable to the measurement of tracer gas or the application of soap solution (eg. instrument air systems in each Unit containment and the underground portion of the fuelling machine duct on elevation 579'). In these situations the ultrasonic noise created by escaping turbulent airflow can be detected. A parabolic ultrasonic detector was available for leak searching of the Unit instrument air supply systems and the pressure relief duct.

3.0 RESULTS AND DISCUSSION

Two intensive tracer gas leak searches were performed around Bruce NGS 'A' containment during the May 1989 station outage. The first leak search was conducted on May 19, 1989 at a containment positive pressure of about 15 kPag. Air samples were successfully returned from 239 of the 249 sites distributed around the containment boundary. A further 13 samples were taken from suspicious locations.

The containment volume at Bruce NGS 'A' is approximately 98,300 m^3. The ethylene concentration in containment was estimated to be about 52 ppm for the first leak search conducted at about 15 kPag.

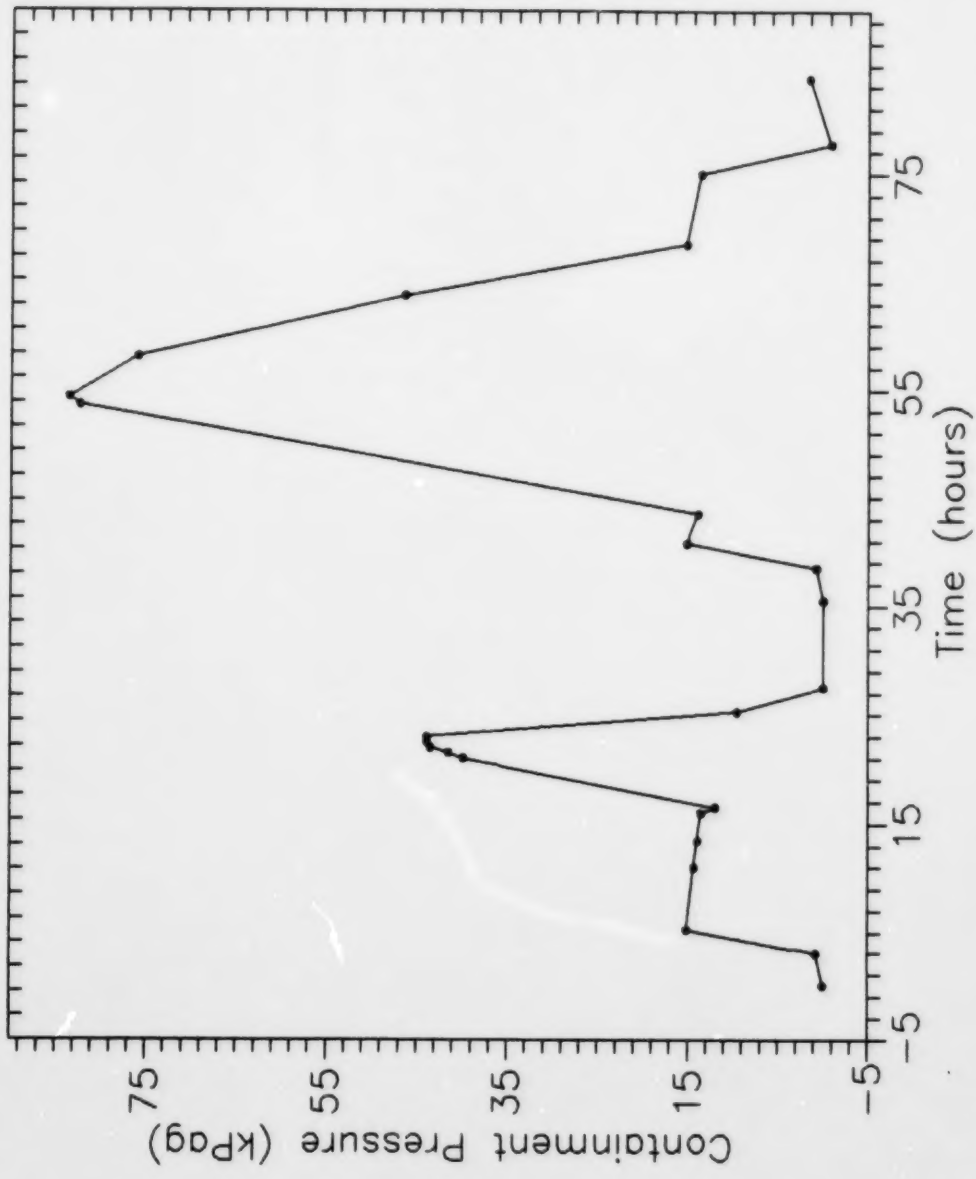
On May 20, 1989 when containment was pressurized to 43 kPag on the way up to 82 kPag, a transfer chamber (24122-TC3) service-side door inflatable seal failed to seal. Containment pressurization could not be maintained and was returned to atmospheric pressure to effect repairs. The pressure test was restarted from the beginning, about 15 hours after the transfer chamber seal failure. The pressurization profile for the May 1989 pressure test as reported by NED /4,5/ is shown in Figure 1. While at atmospheric pressure, two containment air samples were obtained and analyzed for remaining ethylene concentration (see Table A2 in the Appendix). The ethylene concentration in containment prior to restart of the pressure test was found to be about 34 ppm. With the additional dilution that occurs during pressurization and the losses through outleakage from containment, the estimated ethylene concentration at LOCA peak pressure of 82 kPag would be about 19 ppm.

For the second leak search conducted between containment pressures of 70 and 82 kPag on May 21, 1989, 249 air samples were collected at the same sampling locations as for the first leak search. This time all of the bagged air samples were successfully returned for analysis.

The ethylene tracer gas concentrations measured during the two leak searches are given in Table A2 of the Appendix.

FIGURE 1

Bruce NGS 'A' 1989 Pressure Test Profile (Ref.**5**)



Each of the air sample tracer gas concentrations was classified into one of three categories: trace or negligible amounts of ethylene, detectable amounts of ethylene (qualitative detection), and measurable amounts with concentration of tracer reported only in the latter case. Of the 503 air samples collected during the two leak searches, 245 had concentrations which were quantifiable (see Table A2 in the Appendix) and 258 contained only a trace or no detectable amount of ethylene.

The ability of the tracer gas technique to indicate smaller Type 3 leaks is strongly dependent on the position of sampling, the containment pressure, the time for gas diffusion to establish patterns and the unquantifiable influence of ventilation.

For the two tracer gas leak searches described in this report, no single, large turbulent leakpath was found - rather, many small ones were detected. In most cases of high tracer gas concentration, further air sampling or soap spray application performed in the vicinity of the original high tracer gas air sample concentrations led to the discovery of one or more Type 1, 2 or 3 leaks. The soap spray results obtained by the BNPD CMF leak search crews are summarized in Tables I and II/6/.

The leak catcher was available to quantify the leakrate for Type 3 leaks (defined to be leaks having severe foaming, audible hissing or airflow sensed by hand/7/). However, during the Bruce NGS 'A' 1989 station outage, not one of the Type 3 leaks found could be quantified as access with the leak catcher was not possible and/or the surface around the leak was too rough to seal the leak catcher to allow the flowrate to be measured with confidence.

The ultrasonic probe was successfully used to search out instrument air leaks in Unit 1 containment.

3.1 Vacuum Building Basement

Significant levels of tracer gas were detected in the vacuum building basement at 15 kPag. At the higher test pressure (>70 kPag), a ten fold increase in the tracer gas concentration was noted at five of the sampling locations. Although the ventilation in the vacuum building basement is poor, the leakage from several of the J-tube-Pressure Relief Duct seals was enough to raise and maintain the tracer gas concentrations at the higher test pressure.

3.2 Moderator Pump Rooms

During the planning for the pressure test, it was decided that tracer gas air sampling in the Moderator Pump (MP) rooms, the HX rooms and Instrument Room 112 of each Unit would reduce personnel exposure to tritium, when compared to using the soap spraying technique. All of the east and west MP rooms had elevated tritium levels during both leak searches. The increase in containment

TABLE I

SOAP SOLUTION LEAK SEARCH RESULTS AT 14 kPag
CONTAINMENT PRESSURE AS MEASURED BY BNPD CMF STAFF

Penetration ID No	Tracer Gas Reference Test No	Unit No	Trip No	Sample Number	Leak Type	Description
EP 11742	1	1	20	4	2	Inside Rm 224, EL 639' North Vault Wall
EP 11350	1	1	20	4	3	Above Rm 224, EL 639'
EP 11348	1	1	20	4	2	Above Rm 224, EL 639' Instrument air beside leaking
Rm 202	1	2	11	3	na	Water on floor could not test
EP 11459	1	3	13	2	1	Rm 204, EL 615' South Vault Wall
EP 11460	1	3	13	2	1	Rm 204, EL 615'
EP 11611	1	3	13	2	1	Rm 204, EL 615'
EP 11671	1	3	13	2	3	Rm 204, EL 615'; open end of 1/8" tubing from vault
EP 11509	1	4	26	2	1	Above Rm 312, EL 639' West Wall
EP 11348	1	4	26	4	2	Above Rm 224, EL 639' Poison Injection Room
EP 11094	1	4	26	1	1	Inside Rm 224, EL 639'
EP 11099	1	4	26	1	1	Inside Rm 224, EL 639'
EP 1713	1	4	16	8	3	Inside Rm 025, EL 579'
EP 17069	1	4	16	8	3	Inside Rm 025, EL 579' Construction Joint just east of EP 17069
EP 17067	1	4	16	8	3	Inside Rm 025, EL 579' Construction Joint beside EP 17067
EP 17066	1	4	16	8	1	Inside Rm 025, EL 579'
EP 17047	1	4	16	8	na	Inside Rm 025, EL 579' Could not soap
CJ.S09.5	1	0	2	1	2	Basement Unit 0, Construction Joint
EP 41299	1	0	2	2	2	Basement Unit 0, Construction Joint between EP 41299 and EP 41300

TABLE II

SOAP SOLUTION LEAK SEARCH RESULTS AT 80 kPag
CONTAINMENT PRESSURE AS MEASURED BY BNPD CMF STAFF

Penetration ID No	Tracer Gas Reference Test No	Unit No	Trip No	Sample Number	Leak Type	Description
CJ by TC1	2	0	17	2	3	Leak in construction in joint in front of TC1 & TC4, EL 615' on top of fuelling machine duct
Maint Facility	2	0	17	5	3+	
EP 11557	2	1	21	2	1/2/3	On top of Rm 311, EL 639' East Vault Wall
EP 11512	2	1	21	2	1/2/3	On top of Rm 311, EL 639'
EP 11511	2	1	21	2	1/2/3	On top of Rm 311, EL 639'
EP 11466	2	3	13	5	2	East Side of Vault, EL 615'
EP 11467	2	3	13	5	2	East Side of Vault, EL 615'
EP 11071	2	3	13	5	1	East Side of Vault, EL 615'
EP above MV 24	2	4	27	2	3	On top of Rm 311, EL 639' East Vault Wall
CJ above EP 11512	2	4	27	2	3	In Rm 334, EL 639', over top of Rm 311
EP 1713	2	4	16	8	3	Inside Rm 025, EL 579' ECI Pump Room, Construction to the right of EP 1713
EP 17069	2	4	16	8	1	Inside Rm 025, EL 579'
EP 17068	2	4	16	8	1	Inside Rm 025, EL 579'
EP 17066	2	4	16	8	1	Inside Rm 025, EL 579'
AL-18	2	ESA	1	1	3	Mounting for access control Key is leaking EP 41299 and EP 41300

pressure and in exposure time to tracer gas increased the ethylene concentration at least five fold for all of the MP rooms with the exception of Unit 3. For each Instrument Room 112, the ethylene concentration did not exceed 10 ppb for either containment pressure indicating very little inleakage. The east and west HX rooms of Units 1 and 2 had significant tracer gas concentrations whereas very little ethylene was found in the Unit 3 and 4 HX rooms.

3.3 Boiler Rooms

During the 1987 Bruce NGS 'A' Station outage, elevated ethylene tracer gas concentrations were measured in the Unit boiler rooms, particularly Unit 2. After the 1987 Bruce NGS 'A' Station outage, a repair program for the boiler rooms was undertaken and completed/8/. Prior to the 1989 station outage, a tracer gas inleakage experiment was conducted on the Unit 2 boiler rooms. An inleakage rate of 0.9% of the boiler room volume at -14 kPag was measured/9/. It was concluded that after repair, the Unit 2 boiler rooms were not significant contributors to the overall leakrate of the station.

The tracer gas concentrations as measured in the air samples taken in the Unit boiler rooms during the 1989 Bruce NGS 'A' Station outage are given in Table III. The only significant ethylene concentrations measured were in the Unit 2 boiler rooms.

Time of exposure and the increase in containment pressure appeared to have little effect on tracer gas concentrations measured in the boiler rooms. The Unit 2 boiler room concentrations were about a factor of three less than the 1987 measurements at nearly the same containment pressure and ethylene concentration in containment. This indicated that the repair program initiated in 1987 was successful. The tracer gas leakage into the Unit 2 boiler rooms is measurable but small and this is in agreement with the inleakage experiment results for the Unit 2 boiler rooms/9/.

3.4 Unit 4 Room 025

A number of Type 3 leaks were found in construction joints of Room 025 by the soap spray technique. The results are detailed in Tables I and II. The increase in containment pressure and in exposure time to tracer gas along with the modest ventilation in the room kept the tracer gas concentration reasonably constant (140 ppb) during the leak searches (see Table A2).

3.5 Contaminated and Non-Contaminated Stacks

The Units 1 to 4 contaminated stacks had little ethylene (<11 ppb at about 80 kPag) whereas the Unit 0 contaminated stack had about 48 ppb ethylene at about 80 kPag. The extensive leakage from

TABLE III

TRACER GAS RESULTS FOR BRUCE NGS 'A' BOILER ROOMS AT 15 kPag AND >70 kPag CONTAINMENT PRESSURES

Ethylene Concentration (ppb) (Containment Pressure = 15 kPag)			
Unit 1	Unit 2	Unit 3	Unit 4
10	14	<5	8
<10	15	9	15
16	32	15	5
2	30	<10	<10
4	16	<5	10
4	23	<5	18
<5	9	10	8
<5	26	9	10
<10	6	5	6

Ethylene Concentration (ppb) (Containment Pressure = >70 kPag)			
Unit 1	Unit 2	Unit 3	Unit 4
8	8	2	5
<5	10	4	1
<5	13	5	<1
<5	5	5	7
<10	19	3	2
7	20	8	4
7	26	<10	3
2	16	<5	4
2	2	<5	2

Note: The above results were collected during Trips 29 to 36 during each of the leak searches.

construction joint leakage in the Central Maintenance Area is believed to be the major contributor of tracer gas as well as the residual tracer gas released during the TC3 door seal failure.

For the Units 0 to 4 non-contaminated stacks, the ethylene concentrations were <14 ppb at both of the leak search pressures (15 and 80 kPag) with the exception of the Unit 3 stack at 15 kPag which showed 55 ppb. At 80 kPag, the Unit 3 stack had <10 ppb ethylene.

4.0 CONCLUSIONS AND RECOMMENDATIONS

By comparing the building leakage results for 1989 versus the May 1987 outage results, one observes that the 1989 containment boundary leakage rate was still less than 2%/h (the Safety Analysis Value) at all test pressures. The 1989 station leakage rate of about 0.98%/h was very close to the 1%/h Operational Target, about 30% higher than the leakage rate determined in 1987. The 1989 leakage appeared to have an increase in the turbulent component/4,5/.

Despite the earnest repair efforts undertaken since the May 1987 test, the leakage as measured during the May 1989 test has worsened. It can be concluded that a significant leakage source at Bruce NGS 'A' has eluded the tracer gas, soap spray and ultrasonic leak search techniques. It is recommended that the more obscure, uninspected areas of the station containment boundary be considered as potential leak sites.

The tracer gas and soap solution leak searches found the worst areas of leakage to be construction and expansion joints and the PRV EPs. No large turbulent leakpath was found, but rather many small ones were located. A similar conclusion was reached by Civil Research Dept during their visual inspection of the containment concrete/10/.

Ethylene was again demonstrated to be a suitable tracer gas which was easily detected at low concentrations by the gas chromatography method used. To attempt detailed leak searching without the assistance of tracer gas test results would be prohibitively expensive and time consuming. The tracer gas technique was found to be useful both in areas where potential radiation dose to personnel is too high for more time-intensive application of soap solution and in hard-to-reach areas where preparation for soap application would be labour-intensive. It is recommended that a more intensive tracer gas sampling pattern around containment envelope be developed in conjunction with the station ventilation pattern to try to find the hole(s) contributing to the turbulent component of the leakrate.

It is recommended that additional tracer gas cylinders be purchased prior to a pressure test in the event of pressure test problems (such as the improper isolation during the 1987 Bruce NGS 'A'

outage and the transfer chamber seal failure during the 1989 Bruce NGS 'A' outage) causing the tracer gas concentration to decrease and reducing the sensitivity of the leak detection. The additional cylinders would be used to boost the tracer gas concentration to at least original concentration levels (50 to 60 ppm).

More samples of the exhaust stacks of all Units and of containment should be considered in future tracer gas studies.

A detailed examination of the station airflow rate and direction should be undertaken to identify locations where tracer may either buildup due to stagnant conditions or disperse due to high ventilation rates.

It is recommended that on-power sampling of the reactor vault air should be conducted periodically after a tracer gas test to evaluate the decay of ethylene concentration with time.

ACKNOWLEDGEMENT

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Approved by:

D.J.R. Dodd
Manager
Chemical Research Department

Prepared by:

T. Jarv
Scientist
Environmental Science Section

Reviewed by:

O.T. Melo
Supervising Engineer
Environmental Science Section

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TABLE A1

GAS SAMPLE LOCATIONS FOR BRUCE 'A' PRESSURE TEST - 1989

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
1	1	ESA	591	Rm ES113 in front of airlock 18
	2	ESA	591	Rm ES116, on railing (door kickpad label=ES041b)
	3	ESA	591	Rm ES105, vestibule in front of AL17, top of ST5
	4	ESA	591	Rm ES041, on platform railing, east end of room
	5	ESA	591	Rm ES041, under platform, east end of room
	6	ESA	591	Below Rm 116 @ el.578' in stairwell by col SL9
	7	4	579	Near 4N10, east of unit 4 (in basement).
	8	ESA	591	In ECI pump room ES 001 @ col SP11 by ladder 541'
2	1	0	579	Rm S002, sample on south edge of railing near SC9.5
	2	0	579	Rm S004, sample on south edge of railing near SH9.5
3	1	0	579	Sample at SC7 in Rm S006
	2	0	579	Sample at SA7 in Rm S006, 10' north of AL12
	3	0	579	Sample at railing of ST12
	4	0	579	Sample at top of first flight of ST14 in Rm S005
	5	0	579	Sample between SK6 and SK7, about 12' from PRD wall
	6	0	579	Sample in centre of Rm S018, about 12' from AL15
4	1	1	591	East moderator pump room Rm 104 (access control)
	2	1	591	Instrument room Rm 112 (elevation 604')
	3	2	591	East moderator pump room Rm 104 (access control)
	4	2	591	Instrument room Rm 112 (elevation 604')
	5	3	591	East moderator pump room Rm 104 (access control)
	6	3	591	Instrument room Rm 112 (elevation 604')
	7	4	591	East moderator pump room Rm 104 (access control)
	8	4	591	Instrument room Rm 112 (elevation 604')
	9	1	591	West moderator pump room Rm 105 (access control)
	10	1	591	East HX room Rm 106 (access control)
	11	1	591	West HX room Rm 107 (access control)
	12	2	591	West moderator pump room Rm 105 (access control)
	13	2	591	East HX room Rm 106 (access control)
	14	2	591	West HX room Rm 107 (access control)
	15	3	591	West moderator pump room Rm 105 (access control)
	16	3	591	East HX room Rm 106 (access control)
	17	3	591	West HX room Rm 107 (access control)
	18	4	591	West moderator pump room Rm 105 (access control)
	19	4	591	West HX room Rm 106 (access control)
	20	4	591	East HX room Rm 107 (access control)
5	1	1	591	Between 1C9 AND 1C10
	2	1	591	Near 1M10
	3	2	591	Near 2B10
	4	2	591	Near 2M10
	5	2	591	Near 2P9.5, railing of stairs above SDC Hx's
	6	1	579	Between 1B9 and 1B8, about 15' from AL11

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
6	1	0	591	Railing edge near SH9.5
	2	0	591	Midway between SJ9.5 and Rm S147
	3	3	591	Sample near 3B10
	4	3	591	Sample near 3M10
	5	4	591	Sample near 4B10
	6	4	591	Sample near 4M10
	7	4	591	Near 4P9.5, railing of stairs above SDC Hx's
7	1	VB	615	EFADS building in east hall, 10' from PR wall
	2	VB	615	EFADS building in west hall, 10' from PR wall
	3	VB	615	EFADS building, north filter room
8	1	VB	615	Top of stairs ST21, near AL20
	2	VB	615	Top of stairs ST22, near respirator rack TC6
	3	VB	615	On platform between vacuum pipes VP13 and VP14
	4	VB	615	On platform between vacuum pipes VP5 and VP6
	5	VB	615	Halfway along corridor S016, leading to VB
	6	VB	615	On top of TC6 if ladder & scaffold available
	7	VB	615	On platform between vacuum pipes VP1 and VP2
	8	VB	615	On platform between vacuum pipes VP9 and VP10
9	1	1	615	12' from west vault wall between 1C9 and 1C9.4
	2	1	615	Annulus gas area, south wall, between 1G11 & 1H11
	3	1	615	Rm 202 Mezzanine (inside room) use steel ladder
	4	1	615	12' from east vault wall on roof of Rm 210 G11&H11
	5	1	615	12' from east vault wall between 1M8 and 1M9
	6	1	615	Near AL3 in Rm 208
	7	1	615	Sample near 1C8 by AL2
10	1	1	615	Down ST1 to 579', inside Rm 012, or on gate of AL6
	2	1	615	Up ST1 to 615', sample inside Rm 224
	3	1	615	Under Rm 224, beside gas cylinders
	4	1	615	Inside Rm 305, access by ST10 (Locked - use CISA key)
	5	1	615	Near instrument air compressor between 1E6 and 1G6
	6	1	615	Down ST2 to 579', sample centre of Rm 013
	7	1	615	Inside Rm 306 near penetrations
11	1	2	615	12' from west vault wall between 2C9 and 2C9.4
	2	2	615	Annulus gas area, south wall, between 2G11 & 2H11
	3	2	615	Rm 202 Mezzanine (inside room) use steel ladder
	4	2	615	12' from east vault wall on roof of Rm 210 G11 & H11
	5	2	615	12' from east vault wall between 2M8 and 2M9
	6	2	615	Near AL3 in Rm 208
	7	2	615	Sample near 2C8 by AL2

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
12	1	2	615	Down ST1 to 579', inside Rm 012, or on gate of AL6
	2	2	615	Up ST1 to 615', sample inside Rm 224
	3	2	615	Under Rm 224, beside gas cylinders
	4	2	615	Inside Rm 305, access by ST10 (Locked - use CISA key)
	5	2	615	Near instument air compressor between 2E6 and 2G6
	6	2	615	Down ST2 to 579', sample centre of Rm 013
	7	2	615	Inside Rm 306 near penetrations
13	1	3	615	12' from west vault wall between 3C9 and 3C9.4
	2	3	615	Annulus gas area, south wall, between 3G11 & 3H11
	3	3	615	Rm 202 Mezzanine (inside room) use steel ladder
	4	3	615	12' from east vault wall on roof of Rm 210 G11 & H11
	5	3	615	12' from east vault wall between 3M8 and 3M9
	6	3	615	Near AL3 in Rm 208
	7	3	615	Sample near 3C8 by AL2
14	1	3	615	Down ST1 to 579', inside Rm 012, or on gate of AL6
	2	3	615	Up to 615', sample inside Rm 224
	3	3	615	Under Rm 224, beside gas cylinders
	4	3	615	Inside Rm 305, access by ST10 (Locked - use CISA key)
	5	3	615	Near instrument air compressor between 3E6 and 3G6
	6	3	615	Down ST2 to 579', sample centre of Rm 013
	7	3	615	Inside Rm 306 near penetrations
	8	3	615	Inside Rm 023 near wall and second pump
	9	3	615	Inside Rm 023 near manway/ladder and penetrations
15	1	4	615	12' from west vault wall between 4C9 and 4C9.4
	2	4	615	Annulus gas area, south wall, between 4G11 & 4H11
	3	4	615	Rm 202 Mezzanine (inside room) use steel ladder
	4	4	615	12' from vault east wall on roof of Rm 210 G11 & H11
	5	4	615	12' from vault east wall between 4M8 and 4M9
	6	4	615	Near AL3 in Rm 208
	7	4	615	Sample near 4C8 by AL2
16	1	4	615	Down ST1 to 579', inside Rm 012, or on gate of AL6
	2	4	615	Up to 615', sample inside Rm 224
	3	4	615	Under Rm 224, beside gas cylinders
	4	4	615	Inside Rm 305, access by ST10 (Locked - use CISA key)
	5	4	615	Near instrument air compressor between 4E6 and 4G6
	6	4	615	Down ST2 to 579', sample centre of Rm 013
	7	4	615	Inside Rm 306 near penetrations
	8	4	615	Inside Rm 025 outside stairwell

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
17	1	0	615	Take sample in air shaft in NE corner of Rm 215
	2	0	615	Inside Rm 260 near opening to small hole on TC wall
	3	0	615	Transfer chamber port - behind SJ9.5 in Rm S233
	4	0	615	Inside Rm S255
	5	0	615	Transfer chamber port - behind SB7.5 near ST13
	6	0	615	In Rm S213 in front of West Transfer Chambers
	7	0	615	In Rm S215 in front of East Transfer Chambers
18	1	0	615	Outside Rm 233 at elevation 632'
	2	0	615	Inside Rm S246, near north wall of Spent Fuel Bay
	3	0	615	North end of West side of port area S-252, on rail
	4	0	615	South end of East side of port area S-252, on rail
	5	0	615	Inside Rm S-266
20	1	1	639	Sample inside of Rm 312
	2	1	639	On roof of Rm 312, 12' from reactor vault wall
	3	1	639	12' from vault wall on elevated platform, 1C7 & 1C8
	4	1	639	Above roof of Rm 224, attach to grating elev 654'
	5	1	639	Sample inside of Rm 310
	6	1	639	On outside edge of roof of AL4
	7	1	639	Up ST2 to 663', sample on southside of air shaft
	8	1	639	Inside Rm 306 centre of RV wall behind tank
21	1	1	639	Sample inside of Rm 311
	2	1	639	On roof of instrument room Rm 311
	3	1	639	On top of cement shielding wall by 1M10 on east wall
	4	1	639	Sample inside Rm 302
	5	1	639	By 1G11 near platform gas chromatograph, south wall
	6	1	639	12' from vault south wall midway near 1E11 in Rm 303
	7	1	639	Inside Rm 304 near centre of RV wall
22	1	2	639	Sample inside of Rm 312
	2	2	639	On roof of Rm 312, 12' from reactor vault wall
	3	2	639	12' from vault wall on elevated platform, 2C7 & 2C8
	4	2	639	Above roof of Rm 224, attach to grating elev 654'
	5	2	639	Sample inside of Rm 310
	6	2	639	On outside edge of roof of AL4
	7	2	639	Up ST2 to 663', sample on southside of air shaft
	8	2	639	Inside Rm 306 centre of RV wall behind tank
23	1	2	639	Sample inside of Rm 311
	2	2	639	On roof of instrument room Rm 311
	3	2	639	On top of cement shielding wall by 2M10 on east wall
	4	2	639	Sample inside Rm 302
	5	2	639	By 2G11 near platform gas chromatograph, south wall
	6	2	639	12' from vault south wall midway near 2E11 in Rm 303
	7	2	639	Inside Rm 304 near centre of RV wall

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
24	1	3	639	Sample inside of Rm 312
	2	3	639	On roof of Rm 312, 12' from reactor vault wall
	3	3	639	12' from vault wall on elevated platform, 3C7 & 3C8
	4	3	639	Above roof of Rm 224, attach to grating elev 654'
	5	3	639	Sample inside of Rm 310
	6	3	639	On outside edge of roof of AL4
	7	3	639	Up ST2 to 663', sample on southside of air shaft
	8	3	639	Inside Rm 306 centre of RV wall behind tank
25	1	3	639	Sample inside of Rm 311
	2	3	639	On roof of instrument room Rm 311
	3	3	639	On top of cement shielding wall by 3M10 on east wall
	4	3	639	Sample inside Rm 302
	5	3	639	By 3G11 near platform gas chromatograph, south wall
	6	3	639	12' from vault south wall midway near 3E11 in Rm 303
	7	3	639	Inside Rm 304 near centre of RV wall
26	1	4	639	Sample inside of Rm 312
	2	4	639	On roof of Rm 312, 12' from reactor vault wall
	3	4	639	12' from vault wall on elevated platform, 4C7 & 4C8
	4	4	639	Above roof of Rm 224, attach to grating elev 654'
	5	4	639	Sample inside of Rm 310
	6	4	639	On outside edge of roof of AL4
	7	4	639	Up ST2 to 663', sample on southside of air shaft
	8	4	639	Inside Rm 306 centre of RV wall behind tank
27	1	4	639	Sample inside of Rm 311
	2	4	639	On roof of instrument room Rm 311
	3	4	639	On top of cement shielding wall by 4M10 on east wall
	4	4	639	Sample inside Rm 302
	5	4	639	By 4G11 near platform gas chromatograph, south wall
	6	4	639	12' from vault south wall midway near 4E11 in Rm 303
	7	4	639	Inside room 304 near centre of RV wall
28	1	0	639	In centre of Rm 310, new fuel handling room
	2	0	639	Transfer chamber port between ST14 & wall of TC2
	3	0	639	In Rm S308 between breakers and west wall, midway between penetrations in the wall
	4	0	639	Between north wall of east TC and CFA recovery system
	6	0	639	In Rm 313 between breakers and east wall, midway between penetrations in the wall
	7	0	639	Between south wall of west TC and CFA system by SH9.5
29	1	1	678	Boiler room west, sample at 1E8 on walkway
	2	1	678	Boiler room west, sample at 1E9 on walkway
	3	1	678	Boiler room east, sample at 1K8 on walkway
	4	1	678	Boiler room east, sample at 1K9 on walkway
	5	1	678	North service area, middle of north rail by air shaft

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
30	1	1	678	On floor between PHT pumps north side reactivity deck
	2	1	678	Sample at railing on north side of reactivity deck
	3	1	678	Sample at railing on south side of reactivity deck
	4	1	678	On floor between PHT pumps south side reactivity deck
31	1	2	678	Boiler room west, sample at 2E8 on walkway
	2	2	678	Boiler room west, sample at 2E9 on walkway
	3	2	678	Boiler room east, sample at 2K8 on walkway
	4	2	678	Boiler room east, sample at 2K9 on walkway
	5	2	678	North service area, middle of north rail by air shaft
32	1	2	678	On floor between PHT pumps north side reactivity deck
	2	2	678	Sample at railing on north side of reactivity deck
	3	2	678	Sample at railing on south side of reactivity deck
	4	2	678	On floor between PHT pumps south side reactivity deck
33	1	3	678	Boiler room west, sample at 3E8 on walkway
	2	3	678	Boiler room west, sample at 3E9 on walkway
	3	3	678	Boiler room east, sample at 3K8 on walkway
	4	3	678	Boiler room east, sample at 3K9 on walkway
	5	3	678	North service area, middle of north rail by air shaft
34	1	3	678	On floor between PHT pumps north side reactivity deck
	2	3	678	Sample at railing on north side of reactivity deck
	3	3	678	Sample at railing on south side of reactivity deck
	4	3	678	On floor between PHT pumps south side reactivity deck
35	1	4	678	Boiler room west, sample at 4E8 on walkway
	2	4	678	Boiler room west, sample at 4E9 on walkway
	3	4	678	Boiler room east, sample at 4K8 on walkway
	4	4	678	Boiler room east, sample at 4K9 on walkway
	5	4	678	North service area, middle of north rail by air shaft
36	1	4	678	On floor between PHT pumps north side reactivity deck
	2	4	678	Sample at railing on north side of reactivity deck
	3	4	678	Sample at railing on south side of reactivity deck
	4	4	678	On floor between PHT pumps south side reactivity deck
37	5	1	693	Sample at railing by 1H14
	6	1	693	Non-contaminated exhaust Sample at the pressurized end of the plastic tube at the cold finger
38	5	2	693	Sample at railing by 2H14
	6	2	693	Non-contaminated exhaust Sample at the pressurized end of the plastic tube at the cold finger
39	5	3	693	Sample at railing by 3H14
	6	3	693	Non-contaminated exhaust Sample at the pressurized end of the plastic tube at the cold finger

Trip No.	Sample No.	Unit No.	Access Elev.	Description of Sample Locations
40	5	4	693	Sample at railing by 4H14
	6	4	693	Non-contaminated exhaust Sample at the pressurized end of the plastic tube at the cold finger
41	1	0	693	Contaminated exhaust
	2	0	693	Non-contaminated exhaust
	3	1	693	Contaminated exhaust Unit 1
	4	2	693	Contaminated exhaust Unit 2
	5	3	693	Contaminated exhaust Unit 3
	6	4	693	Contaminated exhaust Unit 4
			Note:	All of the above samples must be taken from pressurized end of the plastic tube at the cold finger.
42	1	0	591	Rm S-125 15' from wall by SB9.5
	2	0	591	Rm S-124 Sample at east railing edge by SC9.5
Additional Samples Taken During the Two Leak Searches				
16	8-A	4	615	}
	8-B	4	615	}
	8-C	4	615	} All samples taken in Rm 025 Unit 4
	8-D	4	615	}
	8-E	4	615	}
	8-F	4	615	}
17	9-Rep	0	615	}
	9-A		615	}
	9-B		615	}
	9-C		615	} All samples taken in Spent Fuel Bay area Unit 0
	9-D		615	}
	9-E		615	}
	9-F		615	}
43	1	1	615	Unit 1 containment sample prior to repressurization
	2	1	615	Unit 1 containment sample prior to repressurization
44	1	3	615	Background sample near Unit 3 prior to increasing containment pressure to 82 kPa.

TABLE A2

ETHYLENE TRACER GAS RESULTS FOR BRUCE 'A' PRESSURE TEST - 1989

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
1	1	ESA	591	91	1000
	2	ESA	591	na	51
	3	ESA	591	40	24
	4	ESA	591	na	12
	5	ESA	591	na	14
	6	ESA	591	na	108
	7	4	579	na	36
	8	ESA	591	na	10
2	1	0	579	35	9
	2	0	579	34	27
3	1	0	579	32	36
	2	0	579	44	85
	3	0	579	30	62
	4	0	579	na	24
	5	0	579	<5	27
	6	0	579	29	2
4	1	1	591	55	268
	2	1	591	6	9
	3	2	591	55	346
	4	2	591	9	9
	5	3	591	19	49
	6	3	591	<10	<5
	7	4	591	33	110
	8	4	591	<10	<5
	9	1	591	50	150
	10	1	591	46	55
	11	1	591	30	265
	12	2	591	55	400
	13	2	591	24	36
	14	2	591	42	104
	15	3	591	54	62
	16	3	591	21	5
	17	3	591	22	<5
	18	4	591	77	162
	19	4	591	22	15
	20	4	591	20	<10
5	1	1	591	6	<5
	2	1	591	23	50
	3	2	591	19	<5
	4	2	591	12	5
	5	2	591	36	29
	6	1	579	19	11

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
6	1	0	591	80	49
	2	0	591	7	20
	3	3	591	4	<5
	4	3	591	10	15
	5	4	591	7	<5
	6	4	591	20	4
	7	4	591	22	13
7	1	VB	615	<2	17
	2	VB	615	4	12
	3	VB	615	3	7
8	1	VB	615	10	430
	2	VB	615	57	8
	3	VB	615	15	650
	4	VB	615	40	286
	5	VB	615	34	37
	6	VB	615	84	13
	7	VB	615	62	615
	8	VB	615	95	580
9	1	1	615	3	<10
	2	1	615	16	66
	3	1	615	21	46
	4	1	615	<5	<10
	5	1	615	5	<5
	6	1	615	<5	17
	7	1	615	6	<10
10	1	1	615	14	31
	2	1	615	6	<5
	3	1	615	<10	<5
	4	1	615	<10	8
	5	1	615	5	<10
	6	1	615	7	105
	7	1	615	<10	<5
11	1	2	615	33	27
	2	2	615	<5	<5
	3	2	615	55	110
	4	2	615	15	5
	5	2	615	8	18
	6	2	615	<5	16
	7	2	615	17	<10

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
12	1	2	615	10	43
	2	2	615	9	6
	3	2	615	6	5
	4	2	615	na	4
	5	2	615	<10	5
	6	2	615	10	50
	7	2	615	9	5
13	1	3	615	16	3
	2	3	615	28	5
	3	3	615	na (empty)	3
	4	3	615	6	6
	5	3	615	13	38
	6	3	615	<5	8
	7	3	615	6	8
14	1	3	615	33	10
	2	3	615	<10	9
	3	3	615	<10	2
	4	3	615	10	14
	5	3	615	<10	2
	6	3	615	26	19
	7	3	615	13	12
	8	3	615	39	62
	9	3	615	10	49
15	1	4	615	32	5
	2	4	615	5	<10
	3	4	615	28	21
	4	4	615	16	<10
	5	4	615	10	<10
	6	4	615	21	14
	7	4	615	10	14
16	1	4	615	9	10
	2	4	615	22	24
	3	4	615	16	7
	4	4	615	16	14
	5	4	615	22	9
	6	4	615	<10	16
	7	4	615	21	10
	8	4	615	160	138

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
17	1	0	615	30	55
	2	0	615	190	3000
	3	0	615	110	435
	4	0	615	102	245
	5	0	615	91	6500
	6	0	615	106	290
	7	0	615	27	34
18	1	0	615	32	10
	2	0	615	575	21
	3	0	615	330	34
	4	0	615	330	34
	5	0	615	24	19
20	1	1	639	19	10
	2	1	639	16	<5
	3	1	639	6	<5
	4	1	639	52	<5
	5	1	639	6	<5
	6	1	639	<10	<5
	7	1	639	<10	44
	8	1	639	18	<5
21	1	1	639	<10	5
	2	1	639	<10	40
	3	1	639	16	<10
	4	1	639	14	5
	5	1	639	8	18
	6	1	639	8	<10
	7	1	639	8	8
22	1	2	639	<5	<5
	2	2	639	4	5
	3	2	639	13	8
	4	2	639	<5	4
	5	2	639	16	18
	6	2	639	<10	7
	7	2	639	20	23
	8	2	639	18	<5
23	1	2	639	10	16
	2	2	639	<10	10
	3	2	639	12	13
	4	2	639	24	19
	5	2	639	<10	2
	6	2	639	<10	2
	7	2	639	18	8

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
24	1	3	639	9	4
	2	3	639	10	5
	3	3	639	12	6
	4	3	639	8	26
	5	3	639	28	7
	6	3	639	15	7
	7	3	639	5	16
	8	3	639	7	5
25	1	3	639	25	<5
	2	3	639	17	<5
	3	3	639	13	<5
	4	3	639	16	<5
	5	3	639	18	<5
	6	3	639	7	<5
	7	3	639	12	<5
26	1	4	639	315	5
	2	4	639	326	5
	3	4	639	43	17
	4	4	639	46	24
	5	4	639	24	<10
	6	4	639	27	13
	7	4	639	24	17
	8	4	639	12	7
27	1	4	639	22	14
	2	4	639	20	46
	3	4	639	15	<5
	4	4	639	18	3
	5	4	639	<10	<5
	6	4	639	17	<5
	7	4	639	<10	<5
28	1	0	639	6	8
	2	0	639	<10	<5
	3	0	639	<10	<10
	4	0	639	<5	<5
	6	0	639	6	<5
	7	0	639	na	<5
29	1	1	678	10	8
	2	1	678	<10	<5
	3	1	678	16	<5
	4	1	678	2	<5
	5	1	678	4	<10

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
30	1	1	678	4	7
	2	1	678	<5	7
	3	1	678	<5	2
	4	1	678	<10	2
31	1	2	678	14	8
	2	2	678	15	10
	3	2	678	32	13
	4	2	678	30	5
	5	2	678	16	19
32	1	2	678	23	20
	2	2	678	9	26
	3	2	678	26	16
	4	2	678	6	2
33	1	3	678	<5	2
	2	3	678	9	4
	3	3	678	15	5
	4	3	678	<10	5
	5	3	678	<5	3
34	1	3	678	<5	8
	2	3	678	10	<10
	3	3	678	9	<5
	4	3	678	5	<5
35	1	4	678	8	5
	2	4	678	15	1
	3	4	678	5	<1
	4	4	678	<10	7
	5	4	678	10	2
36	1	4	678	18	4
	2	4	678	8	3
	3	4	678	10	4
	4	4	678	6	2
37	5	1	693	8	<10
	6	1	693	<5	<10
38	5	2	693	8	5
	6	2	693	7	8
39	5	3	693	10	3
	6	3	693	55	<10

Trip No.	Sample No.	Unit No.	Access Elev.	Ethylene Concentrations (ppb) Leak Search #1 (at 15 kPa)	Leak Search #2 (at >70 kPa)
40	5	4	693	<5	14
	6	4	693	14	4
41	1	0	693	6	48
	2	0	693	12	7
	3	1	693	12	<10
	4	2	693	25	11
	5	3	693	22	<10
	6	4	693	26	5
42	1	0	591	32	18
	2	0	591	47	30
Additional Ethylene Tracer Gas Samples Taken During Leak Searches					
16	8-A	4	615	130	
	8-B	4	615	137	
	8-C	4	615	140	
	8-D	4	615	137	
	8-E	4	615	160	
	8-F	4	615	140	
17	9-Rep	0	615	85	
	9-A	0	615	85	
	9-B	0	615	80	
	9-C	0	615	98	
	9-D	0	615	77	
	9-E	0	615	75	
	9-F	0	615	91	
43	1	1	615		33,000
	2	1	615		35,000
44	1	3	615		8

na - not available